

activities which they have to direct, but is, from Secretary Walcott downwards, managed by men who have received their training in the field or the laboratory or the museum; men who are familiar with the needs and difficulties of their assistants; men who combine high ideals with a clear appreciation of what is practicable, and so carry out a consistent policy.

A feature of the National Museum, as of other American museums, is the large amount of exploration undertaken. An expedition, including collectors and cinematographers, is now at work in Africa. Mrs. Purdy Bacon has bequeathed fifty thousand dollars to establish a travelling scholarship for the study of faunas outside the United States. Many other expeditions are here reported on. But we would chiefly emphasise the policy of sending out the officers of the museum to study and collect. The whole of the geological staff was thus employed during the field-season of 1918, filling gaps in the collections, obtaining specimens needed for public exhibition, and taking photographs to illustrate the explanatory labels. Many of the other departments also had members in the field.

Among other signs of life and growth, the report records the inauguration of popular scientific lectures, and the introduction of a Bill to provide a museum of history and of the arts as a memorial to Theodore Roosevelt. The building would afford much-needed space for the rapidly extending National Gallery of Art.

The Religion and Origin of the Hawaiian People.

THE sixth volume of the *Memoirs of the Bishop Museum at Honolulu*¹ continues the publication of Judge Fornander's literary collections. The first portion contains two important papers by native writers on the religion of the Hawaiians. One, by Kamakau, contributed to the collection by Dr. W. D. Alexander, describes certain ancient ceremonies of which the principal are those connected with the pre-natal development of the royal child, the direction of services to the gods, the catching of the fish *opelu*, and the feasts of the year. There are shorter notes on heathen prayers and the ceremonial erection of the *heiau* or god's house. A much longer paper by the Hawaiian author, S. N. Haleole, deals with the functions of the *Kahuna*, "the priesthood called the Order of Sorcery." The word in varying forms (*tahuna*, *tahunga*, *tauna*) is used throughout the Eastern Pacific to denote persons possessed of varying degrees of wisdom from priesthood to sorcery, but in the west, in Tonga and Samoa, has become entirely secularised, and there (in the form *tufunga*) means nothing more than a carpenter or skilled workman.

The *Kahuna* in Hawaii was properly trained for his office, and gave evidence of his powers by divination from pebbles, clouds, shadows, and dreams, and by his magical effects with the *maunai* or cast-away portions of nail, hair, tooth, or clothing. His services were in request in times of war and threatened evils, for house-building or loss of lands, in courtship and medicine. The omens of agriculture, canoe-making, and fishing, with descriptions of the occupations themselves, are fully described.

The second part of this volume contains Fornander's speculations on the "Source and Migrations of the Polynesian Race." This appears somewhat out of date in the present stage of linguistic study.

¹ *Memoirs of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History*. Vol. vi., Nos. 1 and 2. "Fornander Collection of Hawaiian Antiquities and Folk-Lore." Third Series. Parts 1, 2. Pp. 358. Honolulu: H. I. Bishop Museum Press, 1919.)

The author regards India as the original home of the Polynesian people, and supposes that the Polynesian and Aryan language families separated before the latter had developed their inflected form, and that traces of Polynesians are found in the Malay Archipelago. A majority of the immigrants are thought to have passed through Torres Straits to the Loyalty Islands, and thence to Fiji, Samoa, and Tonga. Fornander's so-called evidence is very unsatisfactory. It is based mainly on the casual resemblances of certain Indian words to Polynesian, the Polynesian meanings being read into the Indian word or *vice versa*.

The theory of an Indian origin of Polynesian may be seen to underlie the theories of Macmillan Brown, Percy Smith, Christian, and Churchill, but certainly lacks the support of sound linguistic evidence. According to this view, everything east of India which agrees with modern Polynesian is borrowed from an ancient form of Polynesian speech, though the languages themselves prove that Polynesia has received many of its words from primitive Indonesia, and that not by one migration, from one place at one time, but in several colonisations from various parts of the archipelago at different times.

The final portion of part 2 contains other papers by Fornander on Hawaiian tradition, history, and genealogy.

As all the native writings in the first part are in the original Hawaiian with translations, they form a considerable body of text which will be useful to the student of the language, quite apart from their value in the exposition of Hawaiian religion. The whole work is very clearly and tastefully printed and a credit to the Museum Press. SIDNEY H. RAY.

Soil Temperatures.¹

THE paper by Messrs. West, Edlefsen, and Ewing referred to below is an attempt to predict the probable temperature of any hour of any day. If the mean monthly temperatures of any place are known from previous records, it is possible to represent them by a Fourier series of the form

$$T = a + b \cos(\theta - c) + d \cos 2(\theta - e) + f \cos 3(\theta - g) + \dots$$

where T = temperature at time θ , a = mean annual temperature, b , c , etc. = constants. It is also found for normal days that the temperature at any given hour is a certain percentage of the mean daily temperature, and that this percentage is practically constant irrespective of season. The Fourier series is used to predict the mean daily temperature, which is then multiplied by the appropriate percentage factor to obtain the temperature at the given hour. An arithmetical method, avoiding the use of the Fourier series, is also described. The results are fairly trustworthy for arid regions, but not for humid areas where storms, etc., are frequent.

In Capt. Franklin's third paper on soil temperatures (see "Forecasting Frosts," *NATURE*, January 1, 1920, p. 450) the variations in the ratio of temperature ranges at the 4-in. depth and the surface, $\left(\frac{R_4}{R_0}\right)$, are studied under a variety of weather conditions. The values vary widely, from 0.19 in a very dry soil to 0.85 during heavy rains. The most common value is about 0.40. The influence of the soil-water on tem-

¹ "Determination of Normal Temperatures by Means of the Equation of the Seasonal Temperature Variations, and a Modified Thermograph Record." By F. L. West, N. E. Edlefsen, and S. Ewing. *Journ. Agric. Res.*, vol. xviii. (1920), p. 499.

"The Effect of Weather Changes on Soil Temperatures." By T. B. Franklin. *Proc. Roy. Soc. Edinburgh*, vol. xl. (1920), p. 56.

perature is very marked. The downward percolation of warm or cold rain from the surface to the 4-in. depth causes rapid changes in temperature, especially in sandy soils, when percolation is rapid. After drainage has ceased a rise in temperature may enable it to begin again, owing to the diminishing viscosity of water with increasing temperature. The formation of a dry surface-mulch reduces the value of $\left(\frac{R_4}{R_0}\right)$ owing to the low conductivity of dry soil. But the actual temperature at the 4-in. depth is not greatly reduced by the poor conductivity of the dry soil. This is attributed to the dry surface layers reaching a higher temperature owing to their lessened specific heat, and this counteracts the effect of decreased conductivity. It is shown that a strong dry wind causes the temperature of the surface soil to fall considerably below that of the air. The effect of frost is examined and a formula given for depth of soil frozen in terms of mean surface temperature and duration of frost. A very close relation holds between the date of flowering of coltsfoot and the number of frosts for the two months previous to the date of flowering on open soil not covered with deep snow. It is shown also that strong warm west winds—associated with cyclonic depressions—rapidly raise the temperature of the underground layers of soil in spring. B. A. K.

Control of Insect Pests.

ENGLISH tomato-growers in the Lea Valley are threatened with an annual loss of from 5l.—10l. per acre unless special remedial measures are adopted against the glasshouse tomato moth, *Polia (Hadena) oleracea*. L. Lloyd (Monthly Circular of the Lea Valley and District Nurserymen's and Growers' Association, Ltd.) finds that spraying with lead arsenate for the destruction of the pest must be supplemented by trapping the caterpillars and moths and by destruction of the pupæ. The caterpillars can be trapped in old sacks, and ultimately killed by boiling water, while the moths are attracted to wide-mouthed jars containing brown treacle and ale mixed with 1 per cent. of sodium fluoride. Emphasis is laid on the necessity for ascertaining that each control measure is effective.

Several papers have recently been published dealing with the control of various "borers" that infest crop trees. Attempts have been made to control the peach-borer by means of toxic gases derived from poisonous substances distributed on the soil round the base of the trees. E. B. Blakeslee (Bull. 796, U.S.A. Depart. Agric.) finds that the more usual toxic agents, viz. carbon bisulphide, carbon tetrachloride, sodium cyanide, and naphthalene, are all unsuitable for various reasons, but that para-dichlorobenzene offers distinct possibilities for the purpose. The surface crust about the collar of the tree is broken, the required dose of poison (about 1 oz. per tree from 6-15 years old) distributed evenly about the trunk in a band 1-2 in wide, and a covering of earth applied and moulded up. It is claimed that by this method 94 per cent. of the larvæ can be destroyed.

Much damage is wrought in the United States by the apple-tree borer, which usually takes two or three years to pass through its life-cycle. It is difficult to attack the larvæ by means of poisonous sprays, and mechanical devices are necessarily resorted to. F. S. Brooks (Farmers' Bull. 675, U.S.A. Depart. Agric.) maintains that the most effective method of control is the old-fashioned practice of "worming" with a knife and a piece of wire, but recommends the use of carbon bisulphide when the burrows are obstructed

and the larvæ cannot be reached by the wire. Egg-laying can be prevented by a thick coat of paint applied to the bark of the tree, or by means of wrappings of cloth or newspapers applied close enough to exclude the adult female from the bark. The beetle can be killed by spraying the trees with arsenate of lead, as by this means their food is poisoned, but it is doubtful if this is profitable as a general rule.

A most comprehensive account of the toon shoot and fruit borer (*Hypsipyla robusta*, Moore) is given by C. F. C. Beeson in the *Indian Forest Records* (vol. vii., part vii.). The stages of the insect, its life-history and habits, and studies of its seasonal history are fully described, and from the information thus gained the best methods of control are elucidated. The toon borer passes through five generations in the year; the first is spent in the flower, the second in the developing fruits, and the last three in the young shoots of the current season. The effect of this habit is that the first and second broods cause great injury to the seed crop, and in bad years may hinder seed-formation entirely, whilst the three later broods may completely nullify the season's growth in young trees, and, in any case, they cause great delay in the development of the saplings. It is often of little use to make young plantations in the neighbourhood of old toon trees which are infested with the borer. The young trees are subject to attack from their second or third year onward, but may be somewhat protected by banding the trees breast-high with sacking, and removing and destroying at intervals all the larvæ and cocoons found inside the sack-bands. After the fruits are ripe it is advisable to cut out and burn all shoots that are attacked, and in bad cases a second pruning should be made during the cold weather.

Scientific and Systematic Pomology.¹

IT may be taken as a sign of the development of research in fruit culture in this country, and of the interest which has been aroused in connection therewith among growers of fruit and progressive horticulturists generally, that the well-known firm of nurserymen, Messrs. George Bunyard and Co., Ltd., of Maidstone, has considered the time ripe for the issue of a new quarterly journal devoted exclusively to pomology. The editor, Mr. E. A. Bunyard, a member of the firm named, is recognised both as a practical grower of wide experience and as one of the foremost authorities on systematic pomology and pomological literature. Under his guidance the *Journal of Pomology* should without difficulty establish itself as a publication of scientific value, meeting the needs of a branch of horticulture which has advanced with rapid strides in its importance for the country economically and physiologically since the day when the late Mr. W. E. Gladstone advised farmers to grow fruit for jam production as a remedy for agricultural depression, and is at present none too well catered for in this respect.

The contents of the first two numbers may appear to suggest that there is scarcely occasion yet for a periodical intended primarily to serve for scientific and systematic pomology in this country, some of the more important articles being reprints or abridgments of papers previously published in other journals. Such articles, however, as those by Miss Sutton on self-sterility in plums, cherries, and apples, and by Brooks and Bailey on silver-leaf disease, are of a

¹ *The Journal of Pomology*. Edited by Edward A. Bunyard. Vol. i. Nos. 1 and 2. (Maidstone: Geo. Bunyard and Co., Ltd.) Published Quarterly. Single Nos. 3s. 6d.; Annual Subscription 10s.